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What a Smart Future State Tells a DNO in the Here and Now

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Comparing the **distribution network operator (DNO)** of the past with that of the future makes one thing very clear: the required extent of change is unprecedented. A look at other industries illustrates the size of the leap required. Take the mobile phone industry. Who could have predicted in 1997 that the average handset in 10 years' time would not simply make calls but play music and video, browse the Web, manage e-mail and multi-media messaging, work with touch displays, and offer massive internal storage? The magnitude of that change is comparable to the DNO's smart future.

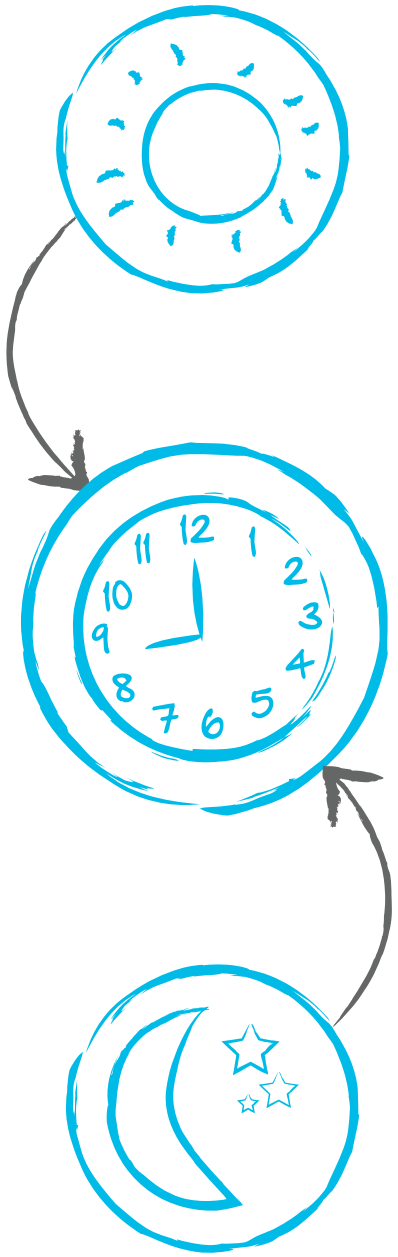
The outcomes of LCNF projects and other research and development have undoubtedly informed DNO decisions regarding the investments needed and adoption of new technologies. Business cases for certain investments will strengthen as assumptions are verified, such as reinforcement deferral through the flattening of power flows. Given the massive investment the network needs and the external factors influencing those requirements (e.g., take-up of electric vehicles), it is clear that smart technologies will be layered on over time, including associated supporting information technology (IT) systems and other non-network technologies.

By envisaging a potential future and then working back from that vision, DNOs can start to understand the "no regret" decisions they can make in the immediate future that will provide the foundation for subsequent layers of innovation. Importantly, these investments need to be defendable from a regulatory perspective: that is, they need to consider customer satisfaction, reliability and availability, safe network service, and other similar factors.

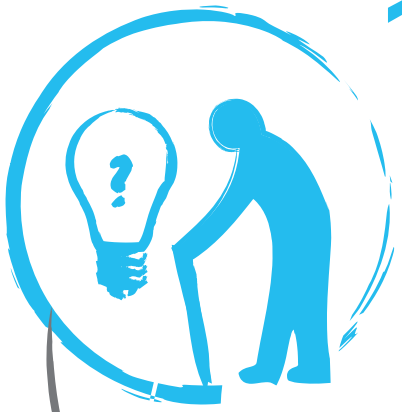
The following "day-in-the-life of a future DNO" scenario offers a view of a future state 10 years from today. While it is by no means intended to suggest what the whole of the network will look like in a decade, we would expect to see a number of the innovations we describe to be in place by then.

Many such scenarios are possible; we created this one to highlight a number of key elements that will be discussed later in the article.

"By envisaging a potential future and then working back from that vision, DNOs can start to understand the 'no regret' decisions they can make."



A Day in the Life Of...



1 Anthony, a vulnerable customer, suffers a power failure. His house lights and desktop computer suddenly turn off.

2 Looking at his home energy display he sees: "Electricity off supply, please phone the Utility of the Future on +44 800 123 456"

3 With no electricity, his VoIP handset is not working and so he finds his mobile. It displays a new message, telling him that a known issue with his supply is being investigated.

4 It also provides a link to access real-time fault progress on a smartphone-enabled website. The delivery time of the SMS tells Anthony that the message was sent less than a minute after his power went off. When Anthony calls the number on his home energy display, a recorded message confirms the content of the SMS and adds that the issue has been identified and will be resolved within 45 minutes.

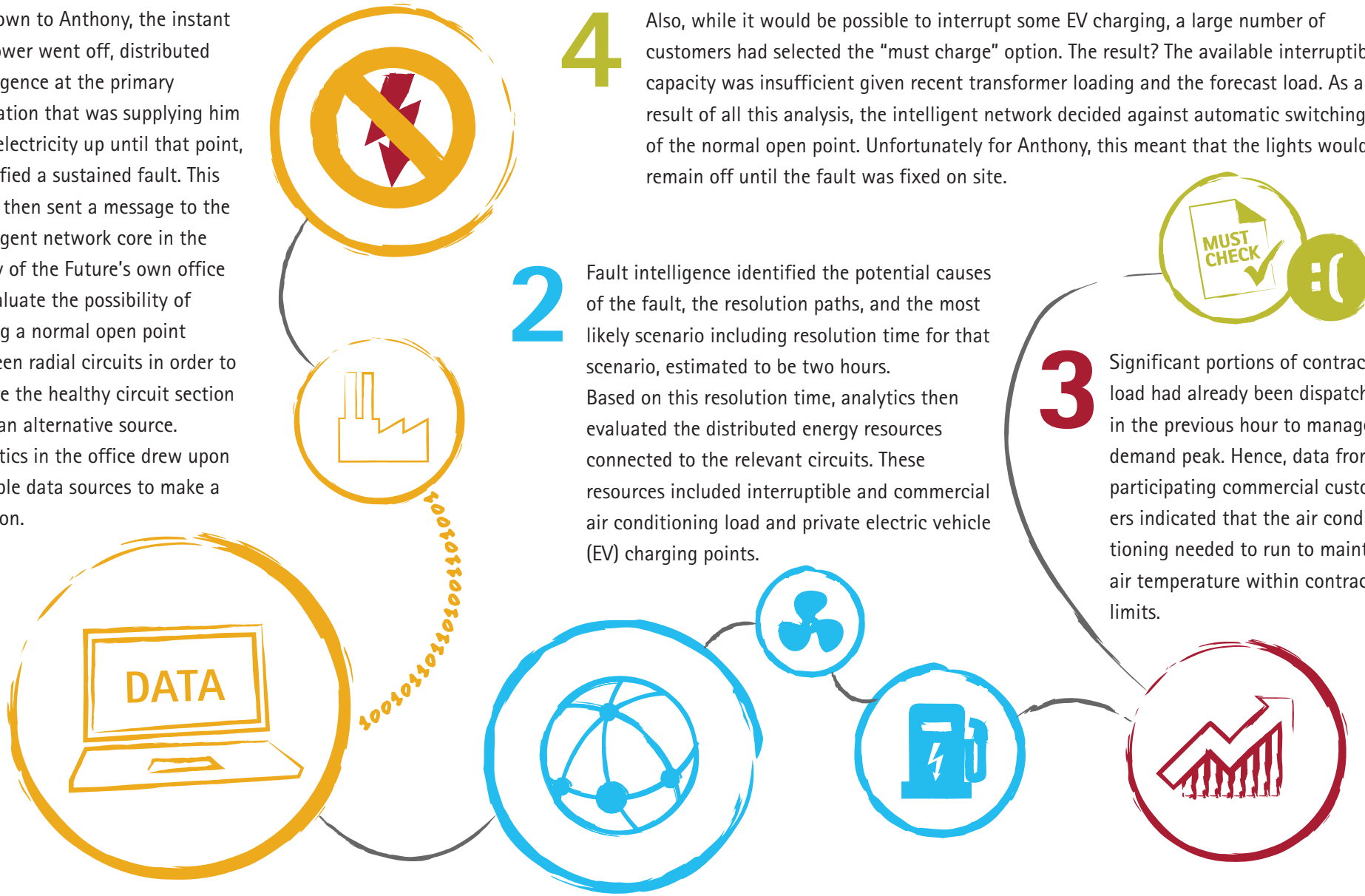
5 it also tells him that a Utility of the Future engineer will visit his house and gives him a password that will confirm the engineer's identity.

1 Unknown to Anthony, the instant his power went off, distributed intelligence at the primary substation that was supplying him with electricity up until that point, identified a sustained fault. This event then sent a message to the intelligent network core in the Utility of the Future's own office to evaluate the possibility of closing a normal open point between radial circuits in order to restore the healthy circuit section from an alternative source. Analytics in the office drew upon multiple data sources to make a decision.

2 Fault intelligence identified the potential causes of the fault, the resolution paths, and the most likely scenario including resolution time for that scenario, estimated to be two hours. Based on this resolution time, analytics then evaluated the distributed energy resources connected to the relevant circuits. These resources included interruptible and commercial air conditioning load and private electric vehicle (EV) charging points.

3 Significant portions of contracted load had already been dispatched in the previous hour to manage a demand peak. Hence, data from participating commercial customers indicated that the air conditioning needed to run to maintain air temperature within contracted limits.

4 Also, while it would be possible to interrupt some EV charging, a large number of customers had selected the "must charge" option. The result? The available interruptible capacity was insufficient given recent transformer loading and the forecast load. As a result of all this analysis, the intelligent network decided against automatic switching of the normal open point. Unfortunately for Anthony, this meant that the lights would remain off until the fault was fixed on site.

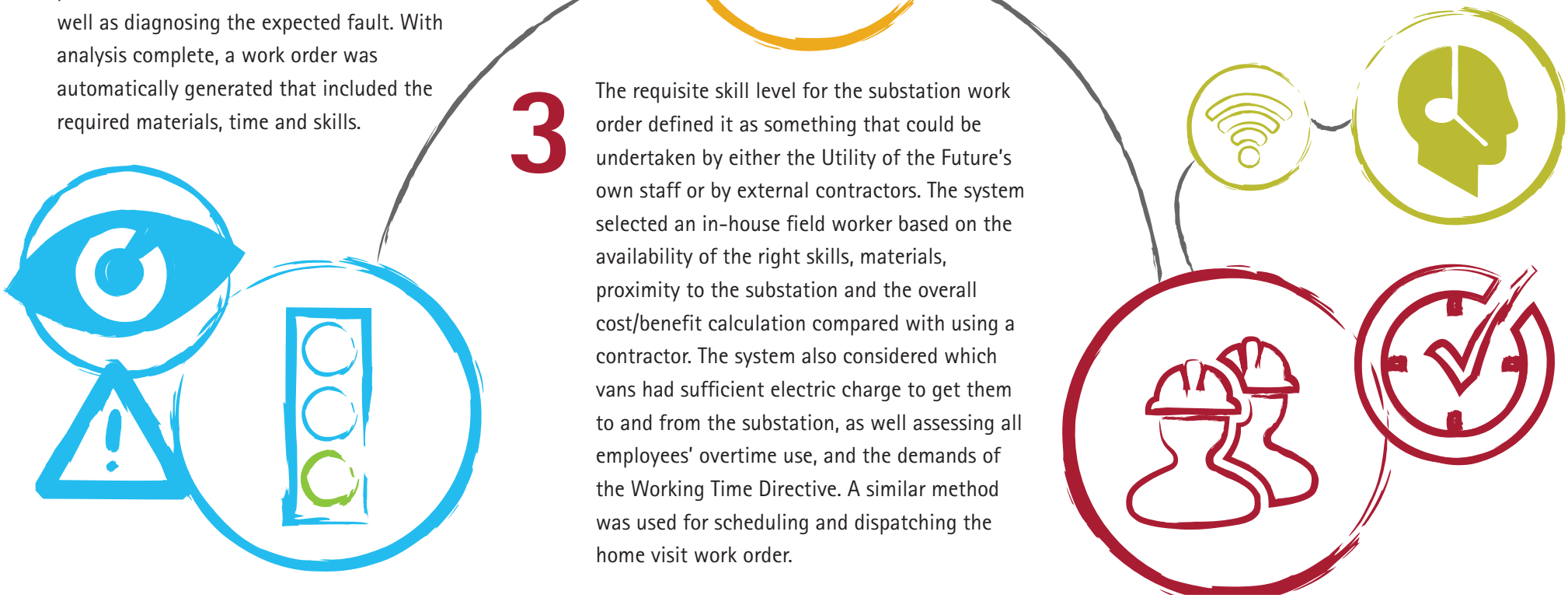


1 At the offshore data centre, through secure channels, further analytics were performed at the substation and underlying asset level. Vast amounts of network data underwent complex event processing to diagnose the offending assets and nature of the fault. Using the previous six months of performance data, installation, and most recent maintenance and inspection dates, the analytics identified that a particular substation was a serial offender as well as diagnosing the expected fault. With analysis complete, a work order was automatically generated that included the required materials, time and skills.

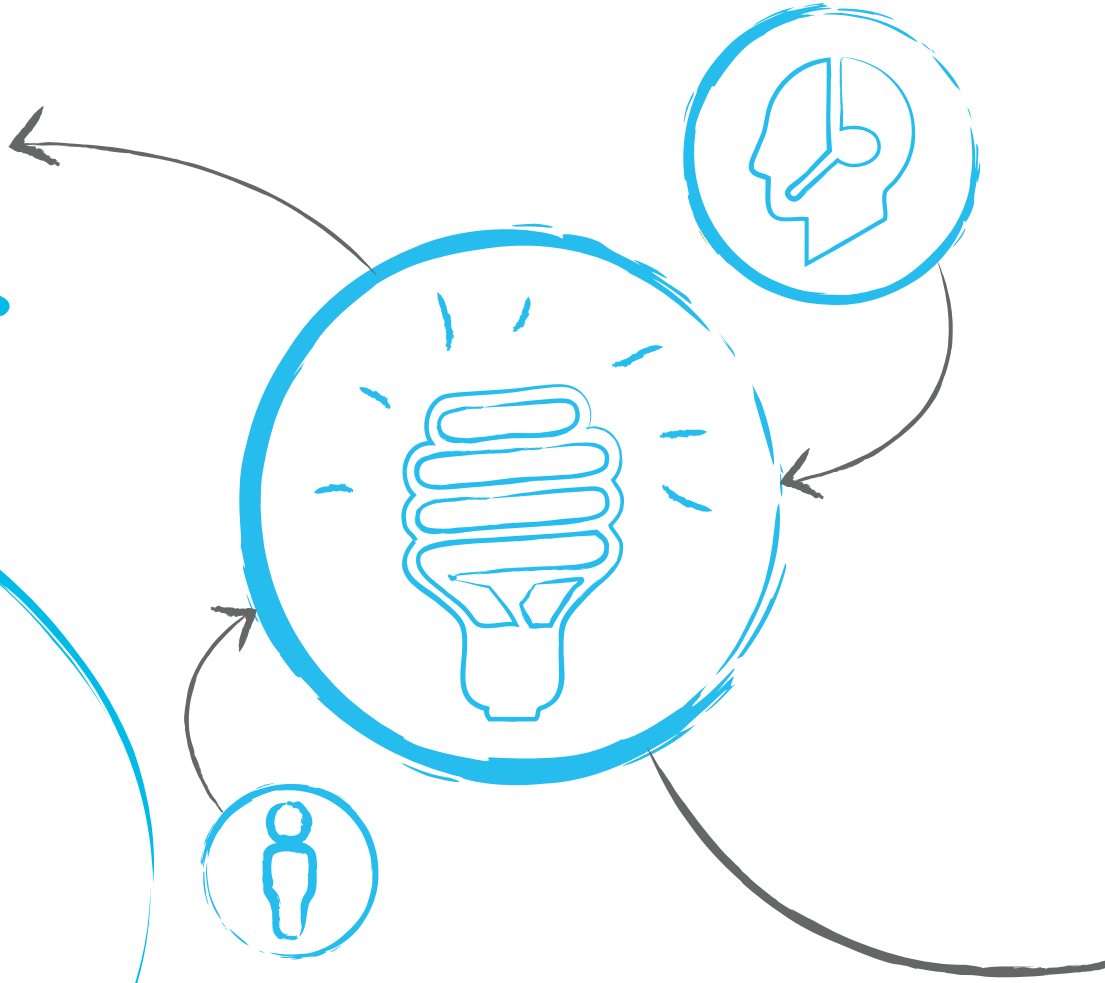
2 Anthony's status as a "vulnerable" person automatically generated another work order for a home visit, along with a verification password.

3 The requisite skill level for the substation work order defined it as something that could be undertaken by either the Utility of the Future's own staff or by external contractors. The system selected an in-house field worker based on the availability of the right skills, materials, proximity to the substation and the overall cost/benefit calculation compared with using a contractor. The system also considered which vans had sufficient electric charge to get them to and from the substation, as well assessing all employees' overtime use, and the demands of the Working Time Directive. A similar method was used for scheduling and dispatching the home visit work order.

4 With the outage confirmed and the fault fully investigated, all affected customers were identified as the geographic information system (GIS) and customer management centres were updated as a result of the analysis performed. This actviity generated the automatic outbound broadcasts to which Anthony, and many others, listened to when phoning up. And all this took less than two minutes.



PRESENT + FUTURE CHALLENGES OF A UK DISTRIBUTION NETWORK OPERATOR



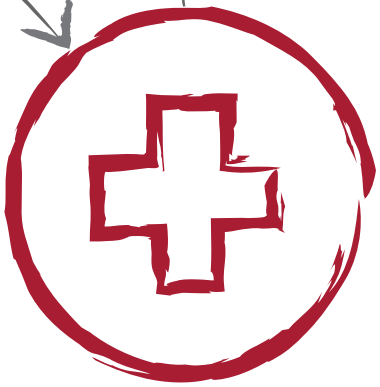
The transition to Ofgem's RIIO Model (Revenue = Incentives + Innovation + Outputs), starting for Gas Distribution in April 2013 and Electricity Distribution April 2015, requires distribution network operators (DNOs) to make decisions about their approach and strategy for a smart grid future and the innovation journey they intend to follow.

The traditional incentive for DNOs to innovate was predominantly to deliver cost efficiency as part of the traditional RPI-X (rate of inflation minus some "X" factor) price control. The introduction of the Low Carbon Network Fund (LNCF) changed that and propelled innovation to the fore during Distribution Price Control Review 5 (DPCR5).

Owing to the success of the LCNF, the new RIIO model encourages similar time-limited innovation, in the form of the National Innovation Competition (NIC) and National Innovation Allowance (NIA). Both of these initiatives will be part-funded, with DNOs providing at least 10 per cent of the funding required.

1 Jamie is already en route to a low-priority inspection order when the schedule change comes in. While driving, his in-vehicle satnav informs him that his next order has changed, and that he is now being re-routed to the new job. Using a voice command, Jamie accepts the new schedule and alters course, triggering the status of the order and estimated time of arrival to automatically update for schedulers and call centre agents. Through the use of global positioning, Jamie's whereabouts are being graphically represented at all times back at the Resource Management Centre.

2 Jamie arrives at the substation location and, from the GPS position he is automatically logged as "on site" in the work management and scheduling systems. As he starts work he knows that, through radio frequency identification (RFID), he has the right tools and materials in his electric van, because the system assessed his equipment prior to assigning the job. Before he begins, he is automatically prompted to complete several key health and safety questions on his handheld device. The device also provides key historic information from previous visits to the substation.

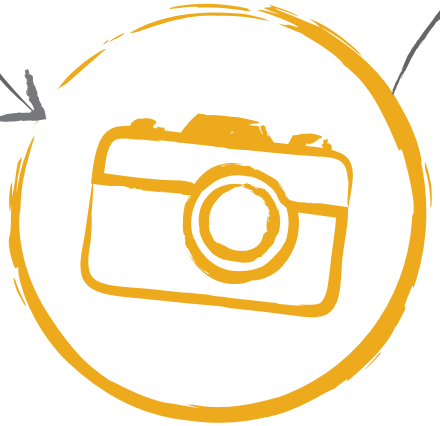


3 During the job, Jamie requires parts that his device shows as being part of the stock in the vehicle he is using that day. As a part is removed from the van, his personal van stock is automatically updated, and the part added to the as-built information associated with the work order.

4 At one point, Jamie is confused about a change that appears to have been made during the last field worker's visit. Via the webcam on his device, Jamie makes a video call to his supervisor, who talks him through an alternative diagnostic procedure. His supervisor's tablet device shows a map with the location of more skilled workers who could be called to assist should the job prove more complex, but in this case remote assistance is enough.

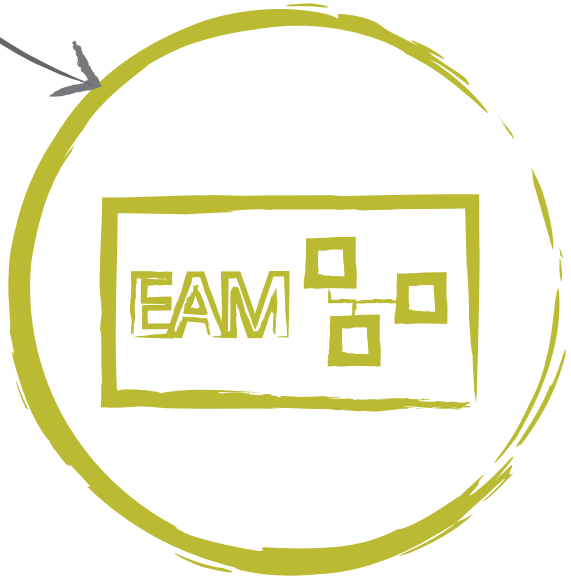
1 After 30 minutes of being on site and out of his stationary van, Jamie's lone worker device vibrates and so he presses the reset button to inform the Resource Management Centre that all is well.

2 During the job, Jamie takes a number of sketches and photographs. All of these are attached to the work order and sent back into the asset change management workflow for incorporation into the composite asset register (including GIS for redline).

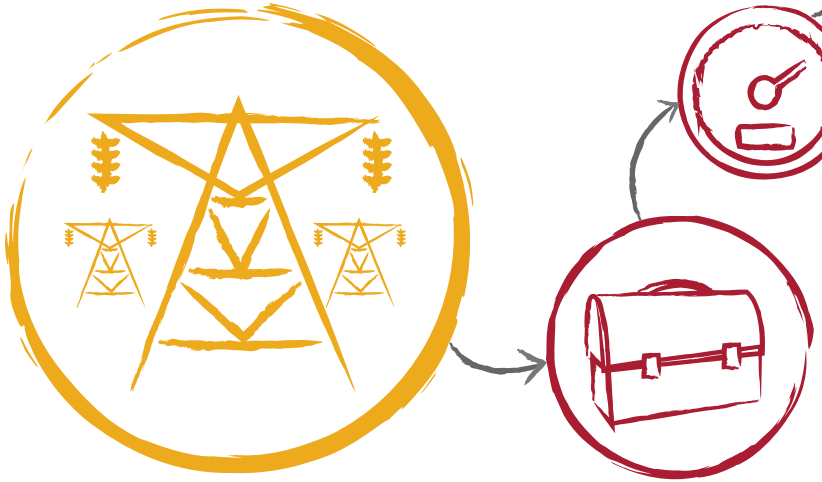


3 With the physical work complete, Jamie selects "Begin testing" on his device. He then completes a series of questions that verifies it is safe to complete the testing and that Jamie is at a safe distance. As a final precaution, Jamie is prompted to enter his unique personal password. At this point, automatic checks are performed to ascertain whether the work has been carried out correctly and the fault rectified. In addition, distributed intelligence at the substation runs an automated check for nested outages and/or issues with other associated assets. Seconds later, his device returns a message informing him that the fault is fixed, the network is restored, and he can leave.

4 Jamie is prompted to enter other work completion data. When he clicks "Complete", the work order closes down, capturing the relevant information (time to complete, materials used, etc.) and asset information (asset replaced, condition of assets within proximity, etc.). This information enters into the core Enterprise Asset Management (EAM) system in the right format for accurate regulatory reporting.



1 This is not the last time that Jamie will visit a substation with similar assets during that week. With a variety of information now captured, further asset analytics can now be started that will aim to identify substations behaving with similar characteristics across the whole network. Vast amounts of historic condition and performance information will be used to identify the specific assets that require preventive interventions. As before, work orders will be automatically generated, scheduled and dispatched. Only this time they are preventive rather than reactive. This automated condition-based maintenance has made certain that Jamie's future work will be undertaken on the right assets and at the right time, and of course prevents Anthony and his fellow customers from suffering from future electricity outages.



2 As Jamie sets off from the substation, he receives an automated instruction to visit his lockbox location to collect a consolidated personalised parts order. Jamie realises that his lockbox is no more than two miles away and his van stock must have dropped below the automatic threshold. Replenishing today will save him valuable time tomorrow morning.

3 In parallel with Jamie's activities, his colleague Pete arrives at Anthony's house. Through the password verification, Pete has spent time with Anthony addressing his concerns and worries about being off supply. The beep of a new SMS on Anthony's mobile, and the return to a kwh/£ view on his home energy display, confirms that the electricity is back on.

4 Intrigued by the efficiency of the Utility of the Future, Anthony looks on the corporate website. He enters his postcode and house number and the page informs him about the fault and the resolution. It also provides him with other metrics on his supply, including power quality figures, renewable energy options and plans that the Utility of the Future has in place to make the electricity supply more sustainable and secure.

WHAT DOES THIS FUTURE STATE TELL US IN THE HERE + NOW?

What is most interesting about this future-state scenario? None of it is science fiction. To varying degrees, all of the elements presented here are based on established or emerging technologies. What the scenario highlights is that there are certain capabilities that can be put in place in the immediate future to establish the first layers of the future smart grid. Conversely, there are investments that may not align with future needs leading to sunk investment that needs to be written off.

Smart solutions are likely to be applied according to local network needs as low carbon adoption progresses unevenly across varying circuits, creating a need to run traditional and smart technologies in parallel.

The following key themes are clearly evident in the scenario:

Customers – Ofgem's priority will continue to be consumer protection. The RIIO model has customers' interests at its heart, tailoring both "output" and "incentive" components towards them. The scenario highlights how customers will experience the advent of smart technologies.

From Anthony receiving direct information through various channels (telephony, home energy display), the provision of real-time fault updates, the identification of Anthony being a vulnerable consumer, availability of key metrics and so on, the potential volume, timeliness and accuracy of communicated information is moving a DNO to operate in a way that makes it closer to a cable television operator. Where appropriate, LCNF pilots provide a perfect opportunity for DNOs to hone their consumer communications to articulate the benefits of smart technologies. Pilots also provide an opportunity to understand customer priorities, concerns and behaviours across different customer segments, develop and test commercial arrangements, and identify appropriate channels of communication for different services.

In conjunction with LCNF pilots, DNOs need to take advantage of the UK-mandated smart metering rollout and educate consumers about the further benefits that will come when the grid moves into a digital era. Communicating those smart grid benefits will be critical to driving consumer adoption.

Indeed, the advent of RIIO provides the potential for consumers to be at the heart of decision making. For example, the population of consumers, affected by an LCNF pilot, could be used as part of a "willingness to pay" assessment and provide further justification for the shape and direction of DPCR6 investment plans.

Integration – System integration is a common theme throughout the scenario: from the distribution management system linking with the customer-facing system, GIS and work management; complex event processing system linking with the work management system, or the supply chain highly embedded within a work management system.

Enterprise application integration (EAI) has been a key strategy for DNOs in recent years, whether that is work and asset management systems, GIS, asset registers, etc. or other such systems. However, what the scenario demonstrates is that DNOs need to carefully evaluate their integration strategies, being mindful of what else might be introduced to the system landscape in the coming years. What's more, history shows that no single IT provider will be able to offer everything to achieve the future state.

Defining the right middleware and framework today will pave the way for a smoother adoption of new technologies and functionality in the future.

Data handling, processing and security – Traditionally, DNOs have not had to concern themselves with handling relatively large volumes of data. In contrast, the exponential increase in data volumes expected with smart technologies will require DNOs to operate in a way that is closer to a mobile phone network. And just as is the case for a mobile phone network, security will be a critical consideration. Cyber terrorism, and public awareness of the threat, makes security one of the most important future considerations for a DNO.

A DNO's future plans for processing large data volumes should inform the decisions it may take in the immediate future. In our scenario, data was processed in an offshore data centre. This possibility might influence a DNO now in a decision about moving to a cloud computing architecture and hosted services.

Data core – Good network investment decisions have always relied on high-quality data. This lack of quality has traditionally been the scourge of DNOs, evidenced by the large number of improvement programmes running across the UK.

DNOs now have the opportunity to establish an accurate and complete data core. Without this, future enhancements will not function and integrate. In fact, there is limited benefit in attempting to add real-time network information on top of weak foundations. For example, a complete GIS connectivity model, at all voltage levels, will be needed in order to facilitate increased functionality of distribution management and customer management systems.

Asset management capabilities – Enhanced asset management capabilities will be required to achieve a number of key tasks including: running R&D programmes, evaluating pilots, developing new design standards, certifying new equipment, designing enhanced asset care regimes such as condition-based maintenance and the rules to be used in complex event processing.

Of course asset management is highly dependent on the data of the existing network being up to scratch and as a result is one of the major users of a strong data core.

Enhancing asset management capabilities now will further support a DNO in justifying and defending its future investment decisions relating to smart technologies—making the right investments at the right time.

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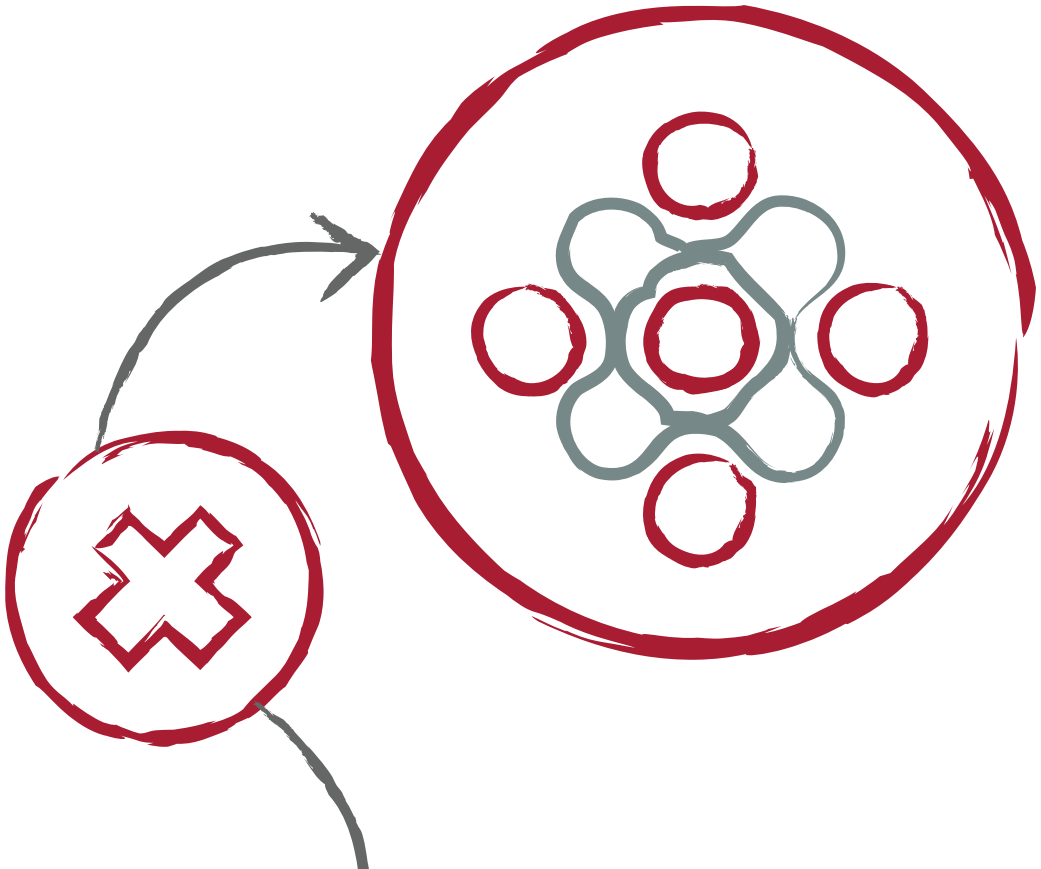


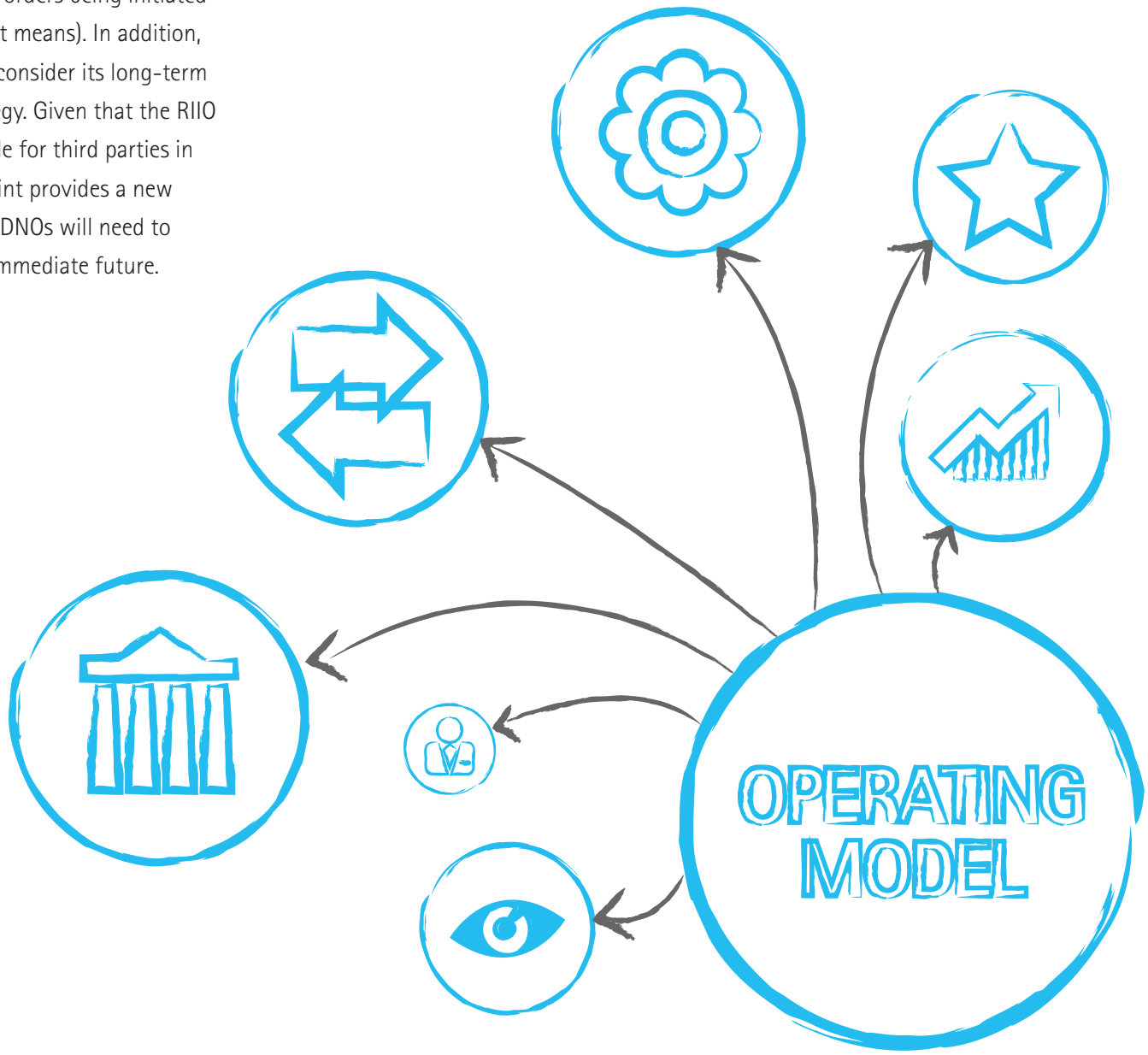
Workforce capabilities – In our scenario, the field engineer, Jamie, was supported by a broad range of functionality to enable efficiency and safety. The majority of the functionality for scheduling and dispatch already exists in the marketplace and is not dependent upon smart technologies. What this reality highlights is that field force enablement solutions can be put in place and/or enhanced now, provided there is a valid business case or health and safety reason to do so.

Workforce capabilities offer a good illustration of layering, with elements such as using electric vehicle capacity in scheduling and dispatch decisions and automatic fault testing being added later.

Operating Model – One of the most important considerations to be made now is operating model design. This design includes seven key elements:

- Leadership – DNO executives need to articulate the future state and the nature of the journey that the whole organisation will follow. They need to offer clarity of vision and demonstrate alignment across the organisation.
- Culture – From back office, to front office, to the engineer in the field, the adoption of new technologies and ways of working need to be established as a positive intervention throughout the organisation. Any existing or recently past change programmes should be candidly assessed in terms of how easily change was accepted. This assessment will provide a baseline and inform a DNO of the necessary attention cultural change will require in the coming years.
- **Processes** – Processes need to be developed with a degree of flexibility to accommodate future automated changes quickly as well as providing the adaptability to "dual run" traditional and smart technologies. DNOs need to fully understand their existing end-to-end processes now and have them fully architected. In addition, supporting data and systems need to be clearly identified in order to provide a solid backbone for future enhancements and changes.

- **Metrics** – A metric-driven organisation needs to be established now, given that in the future the accuracy and timeliness of key information will rise dramatically. If an organisation is not set up to accept greater transparency and accountability, then many of the benefits of smart technologies will be lost.
- **Governance** – Establishing and communicating a decision-making approach that supports the operating model and looks to understand the principles of layering on new technologies.
- **Capabilities** – Centrally rendering key capabilities such as scheduling and dispatch and grid control becomes even more advantageous in the future where there is a wealth of readily available information and a higher degree of automated decision making (highlighted in the scenario through the Resource Management Centre).
- **Organisation** – DNOs need to establish how their organisation will transition from the traditional to a smarter world, accepting that for a prolonged period of time both will be in place (e.g., emergency work orders being initiated through different means). In addition, a DNO needs to consider its long-term contractor strategy. Given that the RIIO model sees a "role for third parties in delivery," this point provides a new perspective that DNOs will need to consider in the immediate future.



Conclusions

While uncertainty persists about networks moving from an analogue to a digital age, it is certain that DNOs will need to manage carefully the lengthy transition they face. Lessons from pilots will be an invaluable source of information and the regulatory environment is set to mature in terms of innovation with the advent of RIIO. Decisions made today need to consider the future state and verify that any subsequent investments do not give cause for regret.

What is a no-regret decision?

A no-regret decision limits stranded asset risks because it is made on the basis of a clear near-term benefit case built on core regulatory value drivers, such as network losses or customer interruptions and minutes lost. The aim is to reduce the business case's dependency on unpredictable energy system developments, while still establishing the foundations for the energy system of the future.

Regardless of the advent of smart technologies, customers will become savvier. A DNO's field force will continue to strive towards greater efficiency. The demand for more information, work and asset management systems will continue to provide the operational backbone. Enterprise systems will still need to be integrated. Data deficiencies will continue to plague DNO decision makers. Operational cost targets will remain. So, while the layering on of the technical elements associated with smart technologies (systems and hardware) is the correct approach, the principle also holds true for the business elements, as capabilities across a DNO's organisation need to transition accordingly.

Accenture services to UK DNOs – Accenture has over 30 years of experience of helping utility clients across the globe to manage the various paradigm shifts that have occurred in the industry. Without doubt, the advent of smart technologies is one of the largest and as such Accenture have adapted accordingly to help support our clients' challenges.

"Accenture's Smart Grid Services focuses on delivering innovative business solutions that enable high performance in the journey to a smarter transmission and distribution grid."

In regard to the day-in-the-life-of scenario, the most pertinent services Accenture offers are as follows:

Accenture's Smart Grid Services

– Accenture's Smart Grid Services focus on delivering innovative business solutions that enable high performance in the journey to a smarter transmission and distribution grid. From automated metering and integrated smart grid planning and deployment, asset management, work management, and field force transformation, Accenture's services provide the in-depth skills utilities need to seek to achieve their strategic and operational goals. Leveraging the company's High Performance Utility Model that reflects the advent of smart technologies, Accenture converges value-driven business strategies with operational leading practices and transformational IT technology solutions that enable utilities to assess their performance against industry leaders, jump-start their own projects and accelerate programme delivery.

In order to provide complete coverage to DNOs, Accenture's Smart Grid Services include distinct offerings, serviced by experienced professionals from both within the UK and across the globe.

Smart Grid Services – Within the UK, the industry participation of our Smart Grid Services includes the following:

- We have supported DNOs with their Tier 2LCNF submissions, providing one DNO with end-to-robust advisory/delivery services.
- We have supported one DNO with its RIIO-ED1 submission specifically focusing on its innovation strategy and process of embedding smart solutions as business as usual. In validating this process we have taken two solutions through this process.
- We have recently been asked to represent the Intellect Technology Association at Ofgem's working group to define how innovation can be incorporated.
- We worked for DECC to define the UK's smart grid vision and route map. This effort involved working closely with the Ofgem smart grid team and the Electricity Network Strategy Group.
- We worked with National Grid, two major UK telecoms firms and United Utilities to develop their UK smart metering and smart grid strategies, and supporting business cases.
- We have worked with the World Economic Forum (WEF) to produce two separate smart grid white papers, "Accelerating Smart Grid Investments" and "Accelerating Successful Smart Grid Pilots".

In more mature markets, Smart Grid Services includes helping our clients with modernisation of the utility infrastructure from production and delivery to consumer consumption. Consulting, blueprinting, program management and delivery of solutions dealing with integration of renewables, better substation and grid management, AMI, demand response and consumer enablement are all elements of Accenture's Smart Grid Services.

About Accenture

Accenture is a global management consulting, technology services and outsourcing company, with approximately 261,000 people serving clients in more than 120 countries. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. The company generated net revenues of US$27.9 billion for the fiscal year ended Aug. 31, 2012. Its home page is www.accenture.com.